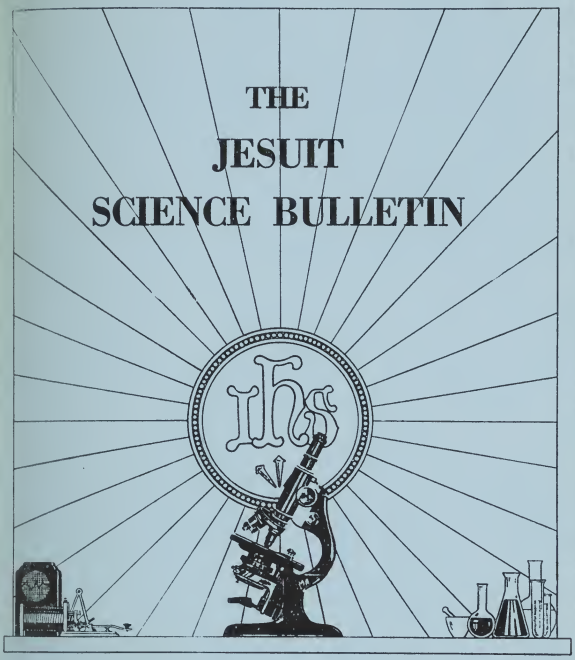
THE JESUIT SCIENCE BULLETIN



AMERICAN ASSOCIATION OF JESUIT SCIENTISTS

(Eastern States Division)

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of the

American Association of Jesuit Scientists

Eastern States Division

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August 27, 28, and 29, 1957
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Vol. XXXV **NOVEMBER 1957** **No. 1**

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Bulletin of the American Association of Jesuit Scientists

EASTERN STATES DIVISION

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NOTICE TO AUTHORS

Manuscripts are to be submitted to associate editors of the appropriate section and *may* be submitted directly to the editor in chief. Clear manuscript, preferably typed, with wide margin to the left, with double spacing between lines, is desirable. Please try to follow the typographical style of the most recent issue of the Bulletin. Line drawings should be submitted on Bristol board, or similar material, and done in India ink. Figure number should be written on this in pencil. Titles for drawings, with figure numbers, should be typed on a separate sheet. Please try to minimize footnotes. Appended references and bibliographies, clearly so marked, should be done in the style of the A.A.A.S. publication, *Science*.

Manuscripts of NEWS ITEMS should be sent to the NEWS EDITOR: Rev. Bernard M. Scully, S.J., Cranwell Preparatory School, Lenox, Mass.

Program

32nd Annual Meeting **Fairfield University**

Tuesday, August 27, 1957

7.30 P.M. FIRST GENERAL SESSION, Xavier Hall.

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Address: Radiation

Rev. Gerald F. Hutchinson, S.J.
President of the Association

Wednesday, August 28, 1957

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Guest Address: Computers in Science Teaching
Mr. Paul Gillis
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Thursday, August 29, 1957

9.30 A.M. THIRD GENERAL SESSION. Xavier Hall.

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Election of Officers

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The Use of Protozoa in Biological Research
Rev. George L. Drury, S.J., Weston College

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Pioneers, Opportunities of Scientists? Part II. Galileo and Descartes.
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Structure and Development of the Normal and Mutant Eye of *Marmoriella*
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Genes and Viruses
Rev. Michael P. Walsh, S.J., Boston College

The Chemistry Section — Rev. Joseph A. Duke, S.J., Presiding

Symposium on the Teaching of High School Chemistry

The Teacher — Rev. William J. Ruppenthal, S.J., Loyola High School, Baltimore

The Student — Rev. Joseph A. Duke, S.J., Wheeling College, Wheeling, W. Va.

The Curriculum — Mr. James J. Fallon, S.J.

Discussion Leader: Rev. George R. Follen, S.J., St. Xavier High School, Cincinnati, O.

Author: *Chemical Principles, a Text for High Schools*

Contributed Papers

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Mr. Charles J. Thomas, S.J., Woodstock College

Photosynthesis of Propyl Iodide
Rev. George J. Hilsdorf, S.J.,
St. Peter's College, Jersey City, N. J.

Free Radical Research
Mr. Donald I. MacLean, S.J.,
Catholic University of America

Electrochemistry of Palladium
Rev. Robert J. Ratchford, S.J.,
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Unimolecular Reactions,
Mr. Ernest G. Spittler, S.J.

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The Mathematics Section Rev. John F. Caulfield, S.J., Presiding

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Canisius College

Extremal Methods of Analysis
Mr. Frederick A. Homann, S.J.

Some Contrasting Results in Euclidean and Non-Euclidean Geometries
Mr. Francis A. Greene, S.J.

Mathematics Institutes for Secondary School Teachers
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Boston College

The Mathematics Curriculum in Secondary Schools
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The Physics Section Rev. Robert B. MacDonnell, S.J., Presiding

High Resolution Raman Spectroscopy of Gases
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Fordham University

Principles of the Maser
Rev. Robert O. Brennan, S.J.,
LeMoyne College

Nevada Test Site and National Defense
Rev. Thomas J. Smith, S.J.,
College of the Holy Cross

Lines of Pre-ionized Levels in Xenon and Krypton
Rev. Matthew Thekaekara, S.J.,
Georgetown University

Use of E-11 Electronic Computer at Georgetown University
Rev. Francis J. Heyden, S.J.,
Georgetown University

The Summer Science Institute at the University of Pennsylvania
Mr. George F. Driscoll, S.J.

Problems of Magneto-hydrodynamics: Plasma Physics
Rev. John H. Kinnier, S.J.,
Weston College

Secretary's Report

FIRST GENERAL SESSION

The thirty-second annual meeting of the American Association of Jesuit Scientists, Eastern States Division, was called to order by Father G. F. Hutchinson, President, at 7:45 P.M. in room 207 of Xavier Hall, Fairfield University. Father Hutchinson introduced Rev. Joseph D. FitzGerald, Rector of Fairfield, who welcomed the members of the ASSOCIATION in behalf of his community.

The minutes of the previous meetings at Georgetown University were approved as presented in the BULLETIN.

Father Hutchinson, elected *in absentia* last year, thanked the members of the ASSOCIATION for the honor bestowed on him. He welcomed the many Jesuits from distant provinces who were in attendance and indicated that they could give their names to the secretary to be added to the membership role and possibly receive the BULLETIN if they so desire.

The following committees were appointed by the President:

Committee on Nominations: Fr. John S. O'Conor, Fr. Joseph A. Persich, Fr. Robert B. MacDonnell.

Committee on Resolutions: Fr. Albert F. McGuinn, Fr. Joseph M. Kelley, Fr. Timothy P. Reardon.

The President then called on Father Bernard A. Fiekers to present a summary of the proposed plan for Cooperative Research among Jesuit Institutions as outlined in THIS BULLETIN, *34*, 94 (1957). Father Francis J. Heyden spoke briefly in favor of many of the ideas presented in this program. Father Joseph F. Mulligan, on the other hand, speaking from experience with a similar type of program set up for Catholic Schools in Metropolitan New York, felt that such a program would not be feasible as outlined. The New York venture involved the expenditure of much time and effort without any comparable addition to the research programs in the several schools. Father George J. Hilsdorf seconded Father Mulligan's view. The Chair thanked all for their participation in the open discussion of the proposal and suggested a private exchange of views take place during the convention, keeping in mind a final discussion and possibly a resolution in regard to the plan at the final general session.

Father Fiekers made a brief plea for more contributions to the BULLETIN.

Father Hutchinson delivered the Presidential Address on the topic of *Radiation*.

A motion to adjourn was carried and the meeting concluded at 9:00 P.M.

FINAL GENERAL SESSION

The final general session was called to order by the President, August 29, at 9:30 A.M. in Xavier Hall. The President first proposed that the ASSOCIATION go on record as taking a definite stand on the question of Atomic and H-Bomb testing. The assembly, by a majority, did not agree or accept favorably this proposal.

The next business concerned the Detroit Cooperative Research Program. An opinion was sought from the members. Mr. Ernest G. Spittler requested information on the relationship the Detroit organization would have with respect to the ASSOCIATION. The advisability of approving or disapproving the program was questioned by Father Michael P. Walsh, since some individual schools, which had been previously informed, had already acted for or against the program. Nevertheless, Mr. Spittler felt that some official recognition of the organization should be made. Expressing a common sentiment, Father James K. Connolly requested more detailed information on the program before a decision be made. If knowledge of the faculties and resources of the schools of the Eastern Provinces with a view to some form of cooperative research be the objective of the ASSOCIATION in entering the Detroit Program, then Father Thomas F. Egan suggested that the BULLETIN be used as a means for disseminating this information. According to Father Walsh nineteen schools had favored the plan and five had rejected it. Perhaps only those against were now voicing their opinions; certainly, in the light of Father Walsh's statement, there must be many present here and now some of those who favored the plan. Personally, Father Joseph A. Duke thought the plan premature, while Father Hilsdorf felt a more thorough study of the proposal be made. Some light on the notion of approval was shed by Father O'Conor. Being of the faculty of St. Joseph's College, which had approved the plan, Father stated that in his opinion approval meant, we are in favor of the idea but as yet we are making no commitments. Father Walsh's statistics were derived from correspondence with Father Edward B. Rooney of the *Jesuit Educational Association*.

The Editor, Father Fiekers gave a report on the status of the BULLETIN. In the past year three issues have been published, the last being a combined issue, with a total of 112 pages for volume 34. The need for articles was stressed as a backlog of articles allows for editorial planning and such a reserve is at present non-existent. Material submitted for publication should be typed with double spacing. A cover letter should be sent on a sheet separate from the manuscript. The publication of news items will be under the direction of

Father Bernard M. Scully, of Cranwell Preparatory School in Lenox, Mass.

The secretaries reported their respective section elections:

Mathematics:	Chairman: Father Stanley J. Bezuszka Secretary: Father Bernard M. Scully
Physics:	Chairman: Father Joseph F. Mulligan Secretary: Mr. Norman A. Pepin

The report of the resolutions committee was presented by Father McGuinn:

1. Be it resolved that the American Association of Jesuit Scientists (ESD) express its gratitude to Rev. Joseph D. FitzGerald, S.J., President of Fairfield University, to Rev. Frederick J. Owens, S.J., Fairfield's Father Minister and to the Fairfield community for their cordial reception and generous hospitality on the occasion of the first Jesuit Science Convention to be held on this beautiful campus.

2. Be it resolved that the Association express its gratitude to Rev. Gerald F. Hutchinson, S.J., President, and to Rev. George L. Drury, S.J., Secretary, and to efficient local committees for their cheerful generosity in making this meeting so enjoyable and profitable.

3. Be it resolved that the Association give its sincere thanks to Rev. Bernard A. Fiekers, S.J., Editor of the Jesuit Science Bulletin, for his continued labor in doing very well a difficult job.

4. Whereas this Association has on the death of Rev. Charles E. Deppermann, S.J., lost one of its most inspiring members, be it resolved that this Association express its profound regret at this loss.

5. Be it resolved that the Secretary of the Association be instructed to send a copy of these resolutions to Rev. Father Rector and Rev. Father Minister of Fairfield University, and a copy of the resolution on Father Deppermann to Rev. Father Vice-Provincial, and to Rev. Father James J. Hennessey at the Baguio Observatory.

Signed: Albert F. McGuinn, Chairman
Joseph M. Kelley
Timothy P. Reardon

It was moved and seconded that the report be accepted.

Father Joseph A. Persich moved that name tags be used for identification at the next convention. The motion was unanimously approved.

Father John S. O'Conor submitted the Treasurer's report, it was accepted as read.

Reporting of the nominating committee:

President: Rev. Joseph F. Mulligan, unanimously elected.
Secretary: Rev. John H. Kinnier, unanimously elected.

Father Mulligan then assumed the Chair and expressed his thanks to Father Hutchinson and Father Fiekers for their untiring work. He pointed out the dangers in creating any form of pressure group to obtain research grants and suggested that the reason for many past rejections is the fact that our men are not well enough known in the proper circles. A motion to adjourn was made and seconded. The meeting concluded at 10:20 A.M. Respectfully submitted, (Rev.) John H. Kinnier, S.J., Secretary.

PROPOSED JESUIT RESEARCH ASSOCIATION

Out of the Conference of Jesuit Schools of Engineering, held at Ames, Iowa on June 28, 1956 has come the proposal to form a Jesuit Co-operative Research Association. It should embrace not only engineering, but pure science as well; and its scope might be extended to embrace whatever fields of knowledge are found in our academic curricula in the Assistancy.

Among the many reasons given, with which most of us are familiar, the following might be emphasized. The pooled research potential of our manpower and our institutions would match that of the very largest in the land—possibly surpass any of them due to the breadth of subject matter to be found in our system. Our geographical distribution might be attractive to government and other agencies, especially in projects of a statistical or survey nature, even in astronomical, geophysical and possibly language projects. More cognizance of a group might be gained in the procurement of grants as contrasted with the recognition of an isolated specialist on an obscure post. Co-operative work between smaller units might eventuate.

Possible financial, jurisdictional and other organizational details have been worked out in part and are now under further study. Active promotion of the proposal comes from the University of Detroit. This proposal is being considered by each of the members of the Jesuit Educational Association at the Collegiate and higher levels and by the governing board of that organization as well. *baf*

Presidential Address

RADIATION*

Rev. Gerald F. Hutchinson, S.J.
Fairfield University

During the last Presidential campaign, the testing of atomic weapons assumed the importance of a major issue. So much so, that President Eisenhower felt it necessary to consult with experts in the field and issue the following statement, as quoted from *U. S. News and World Report,* November 2, 1956.

> "The continuance of the present rate of H-bomb testing—by the most sober and responsible scientific judgement—does not imperil the health of humanity. On the amount of radioactive fallout, including strontium-90, resulting from the tests, the most authoritative judgement is that of the Independent National Academy of Sciences. It reported last June, following a study by 150 scientists of the first rank, that the radiation exposure from all the weapon tests to date—and from continuing tests at the same rate—is, and would be, only a small fraction of the exposure that individuals receive from natural sources and from medical x-rays during their lives."

It was clear then, and still is, that the President's opponent in that campaign, Adlai Stevenson, did not agree with the above statement. Nor was he alone. Nor, indeed, are scientists in harmony regarding important questions concerning bomb testing and radiation in general. Regarding the British tests at Christmas Island, Linus Pauling, an outspoken adversary of atom and H-bomb testing, is quoted in *Time Magazine* for May 20, 1957, as saying:

> ". . . that 1,000 people would die of leukemia as a result of the Christmas Island explosions."

Dr. E. O. Lawrence, in the same issue of *Time* branded such fears as a *lot of nonsense,* flatly declaring:

*Quotations from the book of Jack Schubert and Ralph E. Lapp, *Radiation: What is it and How it Affects You,* The Viking Press Inc., New York, Copyright 1957 by Jack Schubert and Ralph E. Lapp, are hereby acknowledged with the permission of the authors, copyright owners and the Viking Press Inc.

"no one is going to be hurt by the tests carried out by Britain and the United States: the radiation afterwards is so infinitesimal that there can't possibly be any ill effects."

A group of scientific experts testifying before a Special Subcommittee on Radiation of the Joint Committee of Congress on Atomic energy, agreed to disagree on fall-out and radiation hazards, as reported in *Chemical and Engineering News* for June 24th, 1957. And finally, *Time Magazine* asked U. S. and Foreign Scientists to give their views on the danger of radiation. The results were published in the June 3rd, 1957 issue. Here again Linus Pauling, as the most startling spokesman for his point of view, says:

"I estimate that the bomb tests that have been made so far will ultimately have caused the death of about 1,000,000 people in the world. These 1,000,000 people will have died 10, or 20, or 30 years earlier than their normal life span because the radiation has caused bone cancer or leukemia, or some other disease. I estimate also that these bomb tests will cause the birth of 200,000 seriously defective children in the next generation."

Again, E. O. Lawrence, defending the official position of the Atomic Energy Commission as expressed by Dr. Willard F. Libby, Scientist Commissioner, speaks with equal strength: "It is beyond my comprehension" that any reputable scientist should worry about fallout from atomic weapons. He thinks the tests could be continued forever without damage.

These few examples, taken from many, of the difference of opinion both among politicians and scientists, points up the real controversy that rages concerning the dangers from atomic and other sources of radiation. I have thought it, therefore, a fit subject for the presidential address at this convention. Not only will the uncertainty of the subject supply me with a valid excuse for not knowing all the answers, but it is devoutly hoped that it will provoke, during this meeting, ample discussion, both formal and private, among men representing all branches of the sciences, and thus send us all home better informed on a subject whose importance to us, both as scientists and religious, can scarcely be exaggerated.

Amid all the controversy on the subject, there seems to be at least one point on which most scientists agree, namely that an atomic or hydrogen war would be quite as disastrous as most people think it would be. Not only the actual damage done by the explosion of any considerable number of atomic or hydrogen bombs, but also the radiation damage done by fall-out from such, could well be the means of that *destruction of the world by fire* foretold by God

Himself. Therefore our discussion will not concern itself with this phase of the subject, but rather will concentrate on the following points, perhaps less sensational, but considered very fundamental for a proper, intelligent evaluation of the subject.

1) permissible, or tolerable dosage, internal and external; 2) Fall-out; 3) Genetic effects; 4) Medical hazards; 5) Hazards involved in peacetime uses of atomic energy.

Maximum Permissible Dosage. This term, at very best is an ambiguous one. It seems generally agreed that the ideal amount of radiation for an individual to absorb is none. But since radiation is a necessary constituent of modern life, the determination of the maximum permissible dose, is an attempt to set down an upper limit that a human being can tolerate and show no, or at least insignificant, effects while apparently living out the full span of life. Since this can be determined only by watching the effects as people are subjected to radiation, the figures are only probable, the degree of probability depending upon one's ability to interpret the evidence presented and the logic with which one treats the evidence: thus, the wide open field for opinion.

The one constant and nearly uncontroversial frame of reference for this matter is what is known as background radiation. This means the amount of radiation that we are all subject to, avoidable and unavoidable, and includes, the radiation from cosmic rays, from naturally occurring radioactive elements in our building materials and in the atmosphere, from diagnostic x-ray treatment, from x-ray and radioactive element therapeutic treatment, and in general from all sources to which man has been subject, from the beginning. This consists, according to the most common estimates, of approximately 5 roentgens, accumulated over the first thirty years of life.

While figures for maximum permissible dosage are common in the literature, and with fairly good agreement, the significance of these figures and their interpretation, are complicated by many factors. Among them, *Handbook 59 of the U. S. Department of Commerce,* National Bureau of Standards, entitled, *Permissible Dose from External Sources of Ionizing Radiation,* lists the following:

1) Biological Variability: It is nothing strange, in this field, or any other, that people, or animals, do not react alike to stimuli. So, for a group of people, apparently very similar, if the dose of radiation is neither negligible nor overwhelming, some will show more marked effects than others.

2) Latent Period: It is a peculiar characteristic of the biological effects of radiation, that there is generally a considerable time lag between exposure and the appearance of the effects. This

has, at times, run into many years, hence the long wait and careful study of a case history, to obtain the proper data.

3) Recovery and Repair: In the case of somatic, as opposed to genetic, damage, some recovery from radiation effects, does take place, at least in the following sense: If, with a given quantity of x-ray, skin erythema of a certain degree is produced by a skin dose of 700 roentgens administered in one hour, then to produce the same effect with two short treatments separated by an interval of 24 hours, each dose must be 535 r., i.e. a total dose of 1,070 r. Evidently, some sort of recovery from the effect of the first 535 r. has taken place during the 24 hour period. Since 700 r. given at one time produce the erythema in question, the effective dose remaining from the first treatment of 535 r. must have been 165 r. In this case, recovery in the 24 hour period overcame the effect of 370 r.

4) Time Factor: In general, except for genetic effects, radiation effects are more marked, the shorter the time during which the dose is administered. When exposure is extended over a long period of time, considerable recovery takes place even during the period of exposure.

5) Radiosensitivity: Some living organisms may be killed by small doses of radiation, while others will survive much larger doses, of the order of 1 million r. in the case of virus particles. However, in the laboratory, for mammals and man, the spread of the lethal dose for different species is quite narrow, perhaps with a factor of 3 or 4. Tissues likewise, differ in sensitivity. In general we may classify them as follows:

a) Highly sensitive: seriously damaged by 600r or less: 1) bone marrow cells; 2) lymphocytes; 3) cells of testes and ovaries.

b) Moderately sensitive: seriously damaged by 600 to 3,000 r.: 1) growing bones; 2) epithelium of the skin; 3) salivary glands; 4) intestinal and elastic tissue.

c) Radio-insensitive cells: Little or no damage up to 3,000 r.: 1) kidney; 2) liver; 3) mature bone; 4) brain; 5) nervous tissue.

6) Relative Biological Effectiveness: It is generally stated that all kinds of ionizing radiations are capable of producing the same kind of biological effects. However, in their ability to produce some of these effects, certain radiations are more effective than others, in the sense that a smaller dose of these radiations is required to produce a given degree of effect. This is important in that it determines how reliably protection data pertaining to x-rays can be applied to other types of radiation. In general,

for the same tissue dose, densely ionizing particles produce more marked effects than are produced by electrons. In the case of gene mutations, however, the effectiveness is about the same or in favor of electronic radiation.

7) Whole Body Radiation: When the entire body is irradiated, all organs are irradiated, but for obvious reasons some organs receive larger doses than others. In general, the effect of whole body radiation is greater for a given dose than when one part of the body is irradiated. When the whole body is irradiated more or less uniformly, innumerable changes can occur, and it is conceivable that an organ may be damaged because some other organ does not function properly, or because some deleterious agent produced by the radiation has been released into the circulatory system. That something of this nature does occur is indicated by experiments in which some organ, e.g. the spleen, or some part of the body has been shielded from radiation during the exposure of the rest of the body and the animal has been able to survive an otherwise lethal dose.

From a consideration of these factors, and from the fact that any conclusions in this matter must be empirical and the problem is too young for sufficient data to have accumulated, it will be easily understood why it is difficult to specify any maximum permissible dosage and more difficult still to interpret and apply such a dosage when specified. Perhaps the first attempt to set such a limit was made in 1925 by the International Commission on Radiological protection, which set the limiting dosage at 0.2 r. per day. This limit was set largely with the medical profession in mind. In 1936 the United States Advisory Committee on x-ray and Radium Protection cut this limit to 0.1 r. per day. This committee had the Manhattan (Bomb) Project in mind. In 1950 the International Commission on Radiological Protection (NCRP) once more lowered the limit to 0.3 r. per week. In 1956, the key scientists concerned with radiation limits, again urged caution by recommending that the total, as opposed to the weekly, dose accumulated over consecutive decades of one's life be stipulated. The suggested the following: up to 30 years of age, total dose accumulated 50 r.; up to 40, 100 r.; up to 60, 200r.

One of the chief considerations influencing this committee was the genetic factor, and the age of 30 was taken as the first limit because the majority of children are born by the time their parents reach this age.

On February 15, 1957, NCRP issued a more precise formulation that the accumulated dose in roentgens at any age must not exceed five times the number of years past the age of 18.

Because of the factors stated above, it is impossible to state what would be one almost instantaneous lethal dose. It is customary to state that 400-450 r. so received would be fatal within one month to 50% of those exposed. It is called the 50% lethal dose and is usually abbreviated LD-50. It is generally considered, too, that such a dose of 600 r. would be 100% fatal within the same period.

For radiation from emitters taken inside the body, it is generally stated that 0.1 microcurie or 0.1 microgram of radium is the maximum permissible dose. The total background radiation, internal and external, over the first thirty years of life is estimated at 5 r. Thus, a factor of about 10 is allowed for additional dosage.

Fall Out. When an atomic bomb is detonated, nuclei of the fissionable material, U-235 or Pu-239, or in the case of a H-bomb U-238, are split into two approximately equal parts, the splitting taking place in any one of 30 or 40 different ways. The fission parts thus formed range over the middle of the periodic chart from about zinc, atomic number 30, to europium, atomic number 63. The fission products have an excess of neutrons and consequently are unstable, emitting beta and gamma rays. The composite fission-product mixture is composed of more than 100 active isotopes, with half lifes ranging from a few seconds to several years, the most important of which is strontium-90.

A close study of worldwide radioactive fall-out has been made by means of a network of monitoring stations which have been operating in the United States and abroad since 1951. Until recently this network consisted of 88 stations located in 46 countries and territories. During the past few months, the network has been augmented by a number of stations sponsored by various additional governments in cooperation with the U. S. Atomic Energy Commission. The data from this network have been periodically summarized.

When a nuclear device is detonated, all the energy is released in a very short time, measured in millionths of a second. As a result, the temperature of a relatively small volume rises to fantastic levels and all materials in this fire ball will exist as gases. All the fission products, and most of the radioactivity, are inside the high temperature fire ball. The fire ball being less dense, than the surrounding air, will rise to a great height just as a hot air balloon rises until it is in equilibrium with its environment. The cloud of a nominal bomb, 20 kiloton, may rise to an altitude of 40,000 feet, at an initial rate of 200 miles per hour. As long as the fission products remain at this height, no hazards are to be expected at the earth's surface. Howard L. Andrews, in an article in *Science*, September 9, 1955, quoting a Government publication, the *Effects of Atomic*

Weapons, 1950, gives the following table for gamma ray activity from the fission products of such a bomb.

time after detonation	activity-curies
1 min	8.2×10^{11}
1 hour	6×10^{9}
1 day	1.33×10^{8}
1 week	1.3×10^{7}
1 month	2.3×10^{6}
1 year	1.1×10^{5}
10 years	8×10^{3}
100 years	6×10^{2}

As Dr. Andrews notes, these figures appear appalling and even more so when we scale them up 100 fold for a 2 megaton bomb. In the case of the 20 kiloton bomb, detonated sufficiently high above the earth so that it does not carry appreciable amounts of large particles from the earth with it, the fall-out will be delayed or may not occur at all. In still air, the particles fall under the force of gravity according to Stoke's law, which requires that the speed increase with increased size of the particles. 70 days will be required for a 5 micron particle to fall 40,000 feet, while a 16 micron particle will fall in 7 days. Atmospheric conditions will complicate the problem, but very small particles will remain at high altitudes for long periods. Thus, he concludes there will be negligible fallout hazard associated with such a bomb. It seems, too, that most authorities agree on this point. The situation is different when the bomb is detonated at low altitudes when considerable debris may be swept up in the wake of the fire ball and the radioactive particles condense on the larger debris particles. Here, early fall-out will be more serious than late fallout because there has been less chance for radioactive decay. If we consider the situation at plus one hour when fall-out under average conditions will be occurring at a distance of 20-25 miles from the point of detonation, and if there were 1 million curies of activity spread over 1 square mile, the resulting gamma ray dose would be about 8 roentgens per hour. We might then calculate that the *infinite dose*, that is the total radiation dosage which a person would receive who was in the area when fall-out occurred and remained there for an infinite length of time. Of course most of this would occur in the first few days. This infinity dose would amount to about forty roentgens. This is not a lethal dose but would be a very serious contribution, if one were exposed very frequently. Also, it would occur over a restricted area. The pattern of the superbomb fall-out at Bikini March 1, 1954 was not what might have

been expected. In the United States there was less fall-out from the 15 megaton bomb than one would have expected from an explosion releasing one one-hundredth as much power. It was learned, that because of the tremendous power, the debris was swept up into the stratosphere, where it remained as sort of a stratosphere reservoir. This may be held up for a long time, taking from 4 to 7 years or even ten for half the debris to fall out. This is fortunate, because much of the radioactivity is burned out by this time. It has been estimated that a thermonuclear weapon of the *Bravo* type produces a total of about 1 milliroentgen dose to the earth's surface, or a very small fraction of the background radiation. This means that the genetic effect is negligible. The roentgen dose of a much smaller bomb is much greater because of the different fall-out pattern. Fall-out from Soviet bomb tests in 1954, which featured bombs much smaller than the *Bravo* type, produced ten times more roentgen dosage in the United States than did that from all the United States Pacific tests in 1954.

However, from this we should not conclude that there is no radioactive hazard of a global nature from the superbomb. The danger comes from the long-lived fission products such as: cesium-137 (half life 33 years), cerium-144 (half life 280 days), ruthenium-106 (half life 1 year), promethium-147 (half life 2.6 years), and especially, strontium-90 (half life 28 years), which seems to be the most important and certainly has received most attention, both official and in public discussion. Reasons follow. If we assume the detonation of a ten megaton bomb and that the fall-out is uniform around the world, then the radiostrontium fall-out over the 200 million square miles of our globe would be 5 millicuries per square mile. Measurements and estimates are complicated by the two strata distribution. That which penetrates the stratosphere probably is globally distributed, that which does not get into the stratosphere probably is not. AEC officials estimate that when all the strontium injected into the atmosphere from all bombs tested to date (Spring of 1957) falls out, the total will amount to 22 millicuries per square mile in the midwest of the United States. As a side remark on this it means, by calculation, that the explosive energy of all bombs detonated through January 1957 approaches a value of 100 megatons, which is about 50 times the total bomb tonnage dropped on Germany throughout the second World War.

Radiostrontium is most important for three reasons: 1) it is produced in large quantity; 2) it is similar to calcium chemically; 3) it has a half life of 28 years.

Since radiostrontium is not a gamma emitter, it is no hazard except when taken inside the body. Its fallout concentration will be greatest where there is most rain, and that, of course, is where people congregate to grow their food. It will be taken up mostly in dairy products. Since it is a beta emitter, it is assayed in bones removed by amputations, resections, still births and cadavers. A human stillbirth in Connecticut in the spring of 1955 registered 500 micromicrocuries. One in Boston at about the same time registered about 800 micromicrocuries. Sheep bones ashed in 1954 ranged up to 30,000, and some sheep from the hilly calcium deficient areas of Wales exhibited 60,000 micromicrocuries. There are many factors which can influence the interpretation of these figures both ways. If we neglect all these, and further, make the assumption that there will be no further bomb tests between 1957 and 1970, and use the AEC projection of radiostrontium hazard, we are told that 25 mmc strontium-90 would be the highest foreseeable skeletal burden in the United States. Such a burden would be most probable for people born in 1954 and would be attained about 1970. The maximum permissible dose has been set at 0.05 microcuries. Therefore our figure of 0.025 mc is just half that. Likewise 25 mmc strontium-90 will deliver a dose of 2.3 rep (or rad) to the skeleton over a period of 70 years. This is one third the value of the dosage due to natural background. From this it would appear that the radiostrontium already committed to the atmosphere will not constitute a serious hazard to global population. On the other hand, there is little doubt that long range or remote fall-out is a controlling factor in the United States and other nations testing programs. Another point of view has become increasingly popular in recent months; if we consider the maximum permissible dose as one which may produce injury to 0.1% of the population, percentagewise it seems negligible, but on a global calculation, this would mean 2.5 million people. Is this really negligible? Someone has to decide if this is a reasonable, calculated risk!

Schubert and Lapp, from whose book *Radiation,* much of this matter has been taken, conclude this section with this paragraph:

> "In retrospect, it seems almost incredible that man's tossing of 20 lbs. of radiostrontium—as was done in the Bravo Test—into the Pacific air should have such consequences for the world. Yet this represents 1 million curies of strontium-90, and we have set the adult MPC as one ten millionth of a curie. Allowing for fall-out variations with respect to regions of rainfall, and taking into account all bomb tests, this means that every person on the planet could receive a full MPC and yet take in

only one hundred thousandth of his share of the radiostrontium. The nature of man's environment is such that this strontium would never be a hazard to him except for concentration mechanisms such as grazing cattle and certain plants and fish which take up the strontium.

"The world has suddenly become a small sphere—too restricted in surface area for the safe testing of superbombs like the Bravo bomb which was exploded March 1st, 1954.

Genetic Effects. Considerable has already been said incidentally about the genetic effects of radiation. Perhaps nowhere is it necessary to leave so much to speculation because information is obtained only from experience and extrapolation from lower forms of live yields results which cannot be accurately assessed as yet. However, the following seem to be generally accepted principles in judging radiation genetic effects: 1) Radiation does induce mutations; 2) Nearly all mutations are harmful; 3) Any small amount of radiation induces mutations, and therefore, in the strict sense, there is no minimal harmless dose; 4) A given amount of radiation will produce the same number of mutations regardless of the number of people who absorb that radiation. For example, 50 r. will produce the same number of mutations whether it is absorbed by one person or fifty persons; 5) Only a small amount of the effects will be manifested in the first generation since mutated genes are usually recessive. The number of generations required for the full effects, the number of generations required for the mutants to die out, and the degree of harm to each generation, are unknown factors.

The common approach to the problem is a statistical one. First, obtain from statistics the number of physically or mentally defective children born in a given population. Second, attempt to assign a definite percentage of these to background radiation. Third, determine the amount of additional radiation required to double this number. According to best authorities, e.g. Professor H. J. Muller, the present population of the United States will pass on 16 million new mutations to the next total generation of 100 million children. If all these mutations were due to background radiation, 5 r. in 30 years, then the doubling dose would be 5 r. This, then, would be the absolute minimum value necessary to double the number of mutations in the next generation. However, most experts seem to think that the contribution of the background radiation constitutes between 5 and 20% of the total spontaneuos mutations. On this basis, the minimal additional dosage required to double the number of mutations would be between 25 and 100 r.

Studies on fruit flies indicate that the doubling dose is around

400 r., while experiments on mice would seem to indicate that the doubling dose is about 50 r. Again, experienced geneticists, estimate that the doubling dose for human beings is between 30 and 40 r., most probably about 40 r. Keep in mind, this is not a safe dose, or one which would lead to no harmful effects. It is the dose required to double the number of mutations. It means the dose that would increase the number of defective children by 200,000 in one generation and perhaps, ultimately by 1,000,000. A dose of only ten r. would increase the number in the first generation by 50,000 and if continued indefinitely would increase the number by 500,000. Six members of the Committee on the Genetic Effects of Atomic Radiation which reported in 1956, made independent estimates on the total number of mutants which would be induced and passed on to the next generation of 100 million children by a total dose per person of 10 r. to the gonads. Their most probable estimates bunched rather closely around the 5 million mark. This means, too, that an average dose of 40 r. per person would produce a total of about 20 million mutations overall, ten times the number that would be obviously detectable. The temptation is strong to go on playing with such figures. However, the significance of them is not clear to me, and possibly is not, and will not be clear to anyone, until the actual experience of a few generations is in. They do, however, seem to me to indicate possibilities which should not be lightly dismissed. In this connection we have used the figure of 40 r., delivered, of course, to the gonads. Previously, we have given as the maximal permissible dosage to the individual, an accumulated dose of 50 r. for the first 30 years of life, 100 for the first forty and 200 for the first 60.

Medical Radiation. Sometime ago, a Professor of Yale University and radiologist at the Bridgeport Hospital, told me he would not allow himself a tooth x-ray unless it was absolutely necessary and a last resort. Since then I have gathered the impression that radiologists and geneticists are the ones most concerned about the extent of usage of x-ray and other radiation sources in diagnostic and therapeutic practice. Schubert and Lapp in their book previously quoted, give the following rough figures for some x-ray diagnosis. In general Fluoroscopy delivers a higher dosage than x-ray photography: GI series, 15 r.; Barium enema, 5 r.; Gall bladder, 6.5 r.; Pelvimetry, 26.7 to the skin and 3.5 to the ovaries reported; Warts, single doses of 1000 to 1500; Acne, 700 to 800, in weekly doses of 75 r.; Dental 2.2 per picture and 41 for a full mouth; (series, cut in half by the proper use of filters.)

Since very valuable information is obtained from the use of

x-rays, and at the same time, it does not seem that the above figures should be taken lightly, the following recommendations have been made at one time or another and by different authorities: 1) Any x-ray treatment should be in the hands of experts; 2) These experts should know at all times the exact dosage delivered to their patients and to themselves; 3) Filters should be used as widely as possible to cut out rays that are harmful and not directly used in the place and for the purpose intended; 4) Shields should be used to protect parts of the body not intended to be treated. This holds particularly true for the gonads; 5) radiation treatment should not be used for non-malignant growths; 6) A strict record should be kept of the amount of radiation each individual has been subject to. Schubert and Lapp have perforated pages in the front and back of their book tabulated for keeping a personal radiation diary.

There will, undoubtedly be a great variation of opinion regarding the dangers of medical use of radiation. However, it does seem that it should be considered and that we should be aware of the possible consequences.

Peacetime Problems. There is one more source of contribution to the radiation hazards of the future which we will discuss so briefly as to barely mention it. That is radiation from reactor power plants. Power for civilian use has so caught the popular imagination that it is being discussed as though it were just around the next corner—which, indeed, it might well be. However, the hazards connected with it are not so frequently thought of, even by the experts. Dr. G. Hoyt Whipple, health physicist at the University of Rochester's atomic-energy project, reviewed the waste disposal problem on April 26, 1956, before the Philadelphia meeting of the American Industrial Hygiene Association and concluded:

> "In the current wave of enthusiasm for nuclear power, the management of wastes has the position of a stepchild. One risks being branded a Cassandra if he points out, as I am doing today, that waste problems may make or break the nuclear power business . . ."

Thousands of pounds of radioactive waste, most with long half lifes, will have to be disposed of annually, and since the rate of decay cannot be speeded up, what will this problem be after 10 or 20 years of operation. Can any place on land or sea or air be found to store these wastes until they cool off? Then with airplanes, trains, and even automobiles powered with atomic energy, how can they be made fool proof? Run away power reactors are possible, but the possibility is remote with automatic controls, but what of an atomic plane

crash or an atomic train wreck, or atomic automobile collision. Can there be any automatic controls that will prevent the hot radioactive particles from being spewed into the surrounding air? If not is it not possible that such a tragedy would be fatal for a whole city or even large population?

Supposedly we are entering the atomic age. In just as true a sense, from a health hazard point of view, we might say we are entering the radiation age. There are many problems connected with the *Frankenstein* man has built for himself. If it is important enough and man wants it badly enough, he will solve the problems. There seems to be little danger from atomic radiation for our generation. They are, perhaps, problems for the next generation. Their solution will require not only the highest technical skill, but also, the highest ethical discernment. And just as the wisdom of God has directed the mind of man in the exploration of the secrets of the atom, so must it guide him, eliminating all ruthlessness, in the safe exploitation for the good of the human race. Therefore, should our interest be great, both as scientist and as priests and religious, in all phases of radiation.

Biology

The Use of Protozoa in Biological Research, by Rev. George L. Drury. Abstract. Biological research on the cellular level is receiving increased attention as the concept of the biochemical unity of life becomes more firmly established. Among recent developments has been the new importance accorded to protozoa and other microorganisms both as biochemical and phylogenetic tools. As a consequence of their isolation in bacteria-free cultures, the exacting nutritional requirements of many organisms have been established. This knowledge has made possible the development of new microbiological assays for various vitamins and growth factors, studies on the effect of temperature on biochemical systems and new approaches to the study of the effect of drugs and hormones at the cellular level. The isolation and mass culture of ecologically important marine phytoplankton organisms has attracted keen limnological and oceanographic interest. The recent cultivation of symbiotic algae of marine invertebrates opens the way for a penetrating attack on the ecology of

coral reefs and on the biochemical reasons for the success of this symbiosis.

Pioneers, Opportunists or Scientists? Part II, Galileo and Descartes, by Rev. Anthony J. MacCormack. Abstract. If it were possible to separate Galileo the theologian from Galileo the scientist his greatness as a scientist and a pioneer would not be obscured. But those two threads are so interwoven in his life, it is always necessary, first, to discuss his clash with Rome. Apparently, more and more investigators are being convinced Galileo, to the Roman bureaucrats, was simply another troublemaker in a very controversial age. The usual negative action of such officials is to repress vigorously the innovator. He was not condemned as a scientist. For, science then did not have the rank it has today. To the man in the street, scientists who claimed the earth went around the stationary sun, thus contradicting the testimony of one's own eyes, were not worthy of attention.

Galileo was a scientist as his findings and writings demonstrate. But he was even greater as a pioneer. To him seems to go the credit for first combining, *pragmatically,* observation, hypotheses, experiments and their mathematical analyses, i.e. *quantitative measurement.* How much a remarkable pioneer he was can be grasped by comparing his spirit with the one shown by Descartes in his *Principles of Philosophy* published two years after Galileo died, in 1644. It should not be forgotten the school of Descartes tremendously influenced European scientists for nearly 100 years after the publication of the *Principles.*

Viruses and Genes, by Rev. Michael P. Walsh. Abstract. Work on the genetics of viruses has opened up vistas on the chemical basis of the gene. Viruses and genes are so much alike that someone has defined a virus as a plasmagene in the wrong host. Plant viruses are more closely related to plasmagenes while animal viruses are more closely akin to nuclear determinants. Bacteriophages are much more complex than the simple tobacco mosaic virus. They have been known to act like a gene by mutating the typhoid group of bacteria. Closely related to this question of viruses and genes is the problem of the origin of life. Further work in this field will help illustrate some of the mysteries attached to the lower forms of life.

Chemistry

A General Technique for Free Radical Research, by Donald I. MacLean, S.J. Abstract. It has long been known that free radicals are formed when certain vapors are passed through an electrical discharge or through a quartz tube heated to several hundred degrees centigrade or when these vapors are irradiated with ultraviolet light. Less than ten years have passed since it was discovered at Catholic University that these free radicals might be stabilized at liquid nitrogen temperatures. The general technique is to bring the radicals onto a very cold surface immediately after they are created. High vacuum systems must be used to obtain the rapid flow rates necessary to freeze out radicals whose life-times are of the order of a milli-second. A description was given of the specific apparatus being used for the production and study of the imine radical produced in the decomposition of hydrazoic acid.

Mathematics

Mathematical Logic from the Inside Out, by Rev. Joseph T. Clark, Canisius College. Abstract. The purpose of this paper is to review and to present for the first time an *elementary* exposition of the technically significant isomorphism which exists between (a) the exactly sixteen classes of remainder class ring modulo 2 polynomials in modern higher algebra and (b) the exactly sixteen cases of truth-functional composition of unanalyzed statements in the propositional calculus of modern two-valued mathematical logic.

The first part of the paper establishes simply but adequately the existence and the character of the exactly sixteen classes of remainder class ring modulo 2 polynomials in modern algebra. The exposition starts by depicting the crucial differences between particular arithmetic, universal arithmetic, and modern higher algebra. In the latter area the theory of groups is outlined; the nature of group structure is disclosed; group isomorphisms and group automorphisms

are explained. From the subgroups of a group rings are selected for analysis and discussed under the aspects of ring isomorphisms and ring automorphisms. The phenomena of subrings in rings introduce the topic of set partitions by isoid relations, and the necessary and sufficient conditions for classmateship. This subject leads to an analysis of the theory of normal subrings or ideals, and in particular to the number subring which is also an ideal: the remainder class ring modulo 2. On this basis the exactly sixteen classes of remainder class ring modulo 2 polynomials in x and y are constructed.

The second part of this paper exhibits simply but adequately the isomorphism which exists between (a) the previously established exactly sixteen classes of remainder class ring modulo 2 polynomials in x and y, and (b) the exactly sixteen cases of truth-functional composition of analytically unresolved statements, 'p' and 'q', in the propositional calculus of modern two-valued mathematical logic. In particular, the paper discloses in detail that the six standard propositional functions of 'p' and 'q' in mathematical logic: conjunction, lax alternation, negation, the conditional, the biconditional, and strict alternation are all equivalent to specifically interpreted remainder class ring modulo 2 polynomials in x and y.

The paper concludes with one side glance at the historical development of mathematical logic, broad areas of which are illumined by this isomorphism insight, and with another side glance at the possibilities of future exploration in mathematical logic, made possible and put under control by this same isomorphism insight.

The paper is accompanied by a set of 5 copies of several ditto graphed pages exhibiting tables, diagrams, charts, and key formulae to assist audience comprehension of its contents.

Some Contrasting Results in Euclidean and Non-Euclidean Geometries, by Francis A. Greene, S.J. Abstract. If the Fifth Postulate of Euclid is replaced by Playfair's Axiom, namely "Through a given point not in a given line only one line may be drawn parallel to the given line," to which it is equivalent, we can change the statement to read "Through a given point not in a given line more than one . . ." or we may put "Through a given point not in a given line no line . . .". If the first change is made we have Hyperbolic Geometry; of the second change is used we have Elliptic Geometry; but along with this second change we must also change the implicit assumption of Euclid about the infinitude of the straight line to say only that the lines are unbounded.

Using the Saccheri quadrilateral, the equal summit angles are right angles in Euclid, acute in Hyperbolic, obtuse in Elliptic Geome-

try. Using the Lambert quadrilateral which is trirectangular quadrilateral or one half of a Saccheri quadrilateral, it follows that the sum of the angles of a triangle is two right angles; in Hyperbolic, less than two right angles; and in Elliptic, more than two right angles. It further follows that if two triangles have their angles respectively equal, the sides must also be equal; that is, the triangles must be congruent, in Hyperbolic or Elliptic Geometry.

Extremal Methods in Analysis, by Frederick A. Homann, S.J. Abstract. Many problems in analysis can be solved by posing a suitable related problem in the calculus of variations, solving this variational problem, and then showing that this solution also provides a solution to the original problem. Rolle's theorem, Hadamard's determinantal inequality, and the Riemann mapping theorem are discussed as examples of this procedure. Difficulties and limitations of the method can be seen in these examples, and mention is made of other applications in analysis and related fields.

Modern Mathematics Workshops for High School Teachers, by Rev. Stanley Bezuszka, S.J. Abstract. Effective changes in the mathematics curriculum on all levels of instruction can only be accomplished by the cooperative effort of High School and College teachers. At present, Summer Workshops or Institutes provide an opportunity for an intensive course in the background and nature of the proposed changes in mathmatics. Boston College in the Summer of 1957 was host to a group of 45 High School Teachers who participated in a Program designed for Modern Mathematics Teaching. The speakers who participated in the Workshop were: Elmer Mode, Boston University; John MacDonnell, S.J., Weston College; Albert E. Meder, Rutgers University, Executive Director of the Commission on Mathematics; Robert Gildea, RCA Airborne Systems Laboratory; Frank M. Verzuh, Assistant Director M.I.T. Computation Center; John Caulfield, S.J., Boston College; Jackson B. Adkins, Phillips Exeter Academy; John Kemeny, Dartmouth College; Max Beberman, University of Illinois; Nazzareno P. Cedrone, Raytheon Mfg. Company. The workshop was under the direction of Rev. Stanley J. Bezuszka, S.J.

The Mathematics Curriculum in the Secondary School, by William F. Gavin, S.J. Abstract. In recent years the role of mathematics in education has been given greater emphasis. To meet the demands of this trend in education Gonzaga High School has introduced an honors program for mathematics as a substantial ele-

ment. Unlike many current programs, the course being presented is traditional, the new element introduced is the acceleration of the regular curriculum so that the honor students, and these will be carefully selected, will have completed a year of the calculus by the time they graduate from high school. The only change thus far in the program for the complete student body is the introduction of a semester of college algebra in place of solid geometry. The program is experimental and was presented to the Mathematics Section for comment and criticism.

A Modern High-School Mathematics Program,[1] by Rev. John W. Sullivan, S.J. (Boston College High School). Abstract. There is a movement on foot in the field of high-school mathematics to overhaul the curriculum from top to bottom. The present curriculum is allegedly out of date and, due to the tremendous advances in mathematics over the course of the last seventy-five years or so; there are at hand today the means to present mathematics to our high-school students as a logically constructed, intellectually satisfying and meaningful subject. Though as yet these new developments in mathematics have had little impact on our high-school courses, the College Entrance Examination Board has set up a Commission on Mathematics to make an all-out effort to correct this state of affairs. The Commission's aim is the "establishment of a truly modern curriculum in college preparatory mathematics." Several independent groups are working on the same problem, the most prominent of which is perhaps the University of Illinois Committee on School Mathematics.

The long-overdue reform is definitely on the way, and our high school administrators should begin right now taking the necessary steps to be prepared for the change.

ERRATA

34 (1), p. 18 (Nov. 1956). Father John G. Hagen was Director of the Georgetown University from 1888 to 1906; not merely eight years. (Notification of Fr. Francis J. Heyden, S.J., through the author of the article, Fr. John P. Delaney, S.J.).

34 (1), p. 17 (Nov. 1956). Delete (that Fr. Boscovitch) determined the Mason-Dixon line. Editor's fault.

[1] An article published in the *Jesuit Educational Quarterly*, Vol. XX, No. 1 (June 1957), pp. 28-36.

Physics

High Resolution Raman Spectroscopy of Gases, by Rev. Joseph F. Mulligan, S.J., Fordham University. Abstract. There are many advantages for our knowledge of molecular structure in using gas, rather than liquid, samples for Raman spectroscopy. The low concentration of molecules in the gaseous phase, however, makes the intensity of the Raman lines extremely weak, and this had hindered the progress of Raman work on gases for many years. Recently the intensity problem has been largely overcome by the development of two new pieces of equipment for Raman work. Welsh at Toronto and Stoicheff at Ottawa have developed a new high-intensity, low-pressure, mercury arc which is externally cooled by water over the whole discharge region. Welsh has also developed a new multiple-reflection Raman cell using four semi-circular concave mirrors. If these mirrors are coated with multilayer, dielectric coatings, intensity gains by a factor of 100 are possible. As a result of these developments it is now possible to photograph Raman spectra of many gases at comparatively high dispersion in moderate exposure times. Some of the results obtained with this equipment, and its potentialities, were discussed.

Lines from the Preionized Levels in Krypton and Xenon, by Rev. M. Thekaekara, S.J. (Georgetown University). Abstract. The so-called preionized levels are those lying between the two series limits, which are doublet P levels having J values 3/2 and 1/2. The only preionized levels which had previously been known were those observed in absorption spectra by Beutler in the distant ultraviolet region. Microwave discharge in xenon at 16 mm. pressure and in krypton at 35 mm. pressure revealed several new lines in the visible region which are totally absent in conventional low pressure discharge. These lines have been classified as due to transitions from the higher f′ and p′ levels. The lines have half-widths of the order of 1 to 10 wavenumbers. The half-width is large because of the high probability of an atom in one of the preionized levels losing its excitation energy by auto-ionization, a process similar to Auger effect in x-rays. The half-width of the line in frequency units is the direct reciprocal of the mean life of the atom in the given level as may easily be seen from the Heisenberg uncertainty relation. These lines constitute the first experimental evidence for emission lines from the

preionized levels in any of the rare gases and help to complete the term sequences of krypton and xenon.

Problems of Magneto-Hydrodynamics: Plasma Physics, by Rev. John H. Kinnier, S.J. (Weston College). Abstract. The existence of a large scale uncontrolled thermonuclear reaction sets before us the possibility of controlling the reaction so as to derive from it economically useful power. Calculations based on reaction cross sections and reaction rate parameters establish the necessary conditions for a favorable power balance. The extreme conditions of temperature, pressure and density which result render ordinary methods of inducing the reaction and confining the reacting region impractical. One possible solution is to confine the hydrogenous plasma in a self-constricting magnetic field which has the added advantage that adiabatic compressional processes may be able to extract energy directly from the reacting region.

Physics Education in Post-War Germany, by Rev. James J. Ruddick, S.J. Abstract. The German and the American student begin their education at about the same age. If they develop an interest in physics and go on to achieve the doctorate degree, it will take them about the same length of time, although the paths they follow will be considerably different.

The student in a German *Volksschule* (grammar school) may, if he is qualified, transfer at the end of four or five years to one of the various types of *Gymnasium*. The real test of his ability comes at the end of the nine-year *Gymnasium*-course. If he achieves the *Abitur*, he is qualified to enter a university,—and is practically sure that no academic difficulty stands in the way of his reaching the doctorate.

In the *Gymnasium* the student is introduced to physics by means of a course somewhat like our college course in introductory physics. In the university, of course, the physics student studies only physics and allied subjects. When he has mastered his matter well enough to obtain his *Diplom*, he is normally allowed to begin work on his doctoral research project. In this project he is rarely given any assistance by his director, but rather is left completely free to choose and work out a problem by himself. According to plan he would receive his doctorate at about 25 years of age. However, circumstances often cause a delay of two or three years.

News Items*

Boston College. Over three hundred doctors attended the fifth annual reunion of medical alumni this Spring. Dr. Andre J. deBethune has been appointed divisional co-editor for theoretical electrochemistry of the *Journal of the Electrochemical Society*. Dr. deBethune did his undergraduate work at St. Peter's College in Jersey City. The *Journal of Chemical Education* for September 1957 (*34*, pp. 433-9) carries an article by Profs. T. Licht and A. deBethune on Recent Developments Concerning the Sign of Electrode Potentials. Dr. Joseph Bornstein, Boston College Chemistry staff and alumnus, has received a Cottrell grant of $1690 from Research Corporation. Boston College ranked high in the list of contributors from certain liberal arts schools to the chemical literature. (*Journal of Chemical Education*, *34* (1957) pp. 352-3). Fr. Albert F. McGuinn is now serving on the screening committee for post doctoral grants by the National Science Foundation. Fr. William G. Guindon, Chairman of the Physics Department, has been elected first President of the newly organized Sigma Xi Club.

An outline of the new four-year philosophy spread in Boston College curricula and concomitant other revisions of the curriculum appears in an article: *Ratio Studiorum Up to Date*, by Fr. W. V. E. Casey, Dean of the Liberal Arts College, in the *Boston College Alumni News*, Summer 1957 issue, pp. 2-3. Simultaneously with this four-year philosophy spread comes a reorganization of the freshman curriculum in chemistry. All freshmen will attend two lectures per week in common (B.S. Biology students start chemistry in sophomore, and will commence with this group next year). No matter what a student's major be, this will provide the common introductory course, with lectures to be given by one of the professors. A third hour per week entails the breaking up of this larger group into a number of smaller groups of about twenty-five to thirty students apiece for discussion of a given week's work. These additional classes are divided among the members of the chemistry staff. Laboratory sections are organized in a similar manner, in charge of certain staff members with the aid of graduate assistants. Thus, to the unity of a

*Rev. Bernard M. Scully, S.J., Cranwell Preparatory School, Lenox, Mass., kindly taken up duty as News Editor. Kindly send news items to him. Ed.

common syllabus of lectures, exercises and assignments, is lent the variety of a more penetrating effort to contact the individual student with maximum efficiency. Contact of better students with research professors is thus assured.

Canisius College. The second annual Radiological Safety Conference, co-sponsored by Canisius College and the N. Y. State departments of labor and commerce, was held on the campus June 12, 13 and 14, 1957. This is the only conference of its kind in the state and one of the few in the nation. Dr. Herman Szymanski, chairman of the chemistry department at the College, was the director.

An Institute in Infra-Red Spectroscopy was conducted at Canisius College, Sept. 9-13, 1957, for industrial personnel. Staff included representatives from Baird Atomic Inc., the National Aniline Div. of Allied and Chemical Dye Corp., as well as the E. I. DuPont de Nemours Co., Inc. and the Beckman Instruments Co.

Canisius leads the Catholic Colleges for the number of contributions to the chemical literature over five years, according to a recent survey of selected liberal arts colleges (*Journal of Chemical Education 34* (1957) pp. 352-3).

Fordham University. Beginning in September, 1957, the Department of Physics will schedule more of its graduate courses in physics at late afternoon hours on weekdays, and on Saturday mornings. This is to accommodate the large number of high school teachers and industrial scientists who are interested in doing advanced work in physics.

Recent publications from the Physics Department include: Victor F. Hess and A. W. Manning, *A Study of the Ionization Produced in Various Gases by Cosmic Radiation,* Transactions of the American Geophysical Union *37,* 676-678 (1956); Daniel F. McDonald (with K. J. Germeshausen and S. Goldberg), *A High-Sensibility Cathode-Ray Tube for Millimicrosecond Transients,* Institute of Radio Engineers Transactions on Electron Devices, *4,* 152-8 (1957).

The Physics Department has received a donation of $2,500 from the Tektronix Foundation toward the purchase of a high-speed oscilloscope. The oscilloscope is to be used by D. F. McDonald, Instructor in Physics, for millimicrosecond-pulse studies of phosphors.

More recent publications from the Physics Department include. Rev. Frederick Canavan, S.J. (with J. O. Rasmussen and J. M. Hollander), Energy Levels of Neptunium-237 Populated by the Beta

Decay of Uranium-237, Physical Review *107*, 141-155 (July 1, 1957). This represents part of the work done by Father Canavan while he was working at the University of California Radiation Laboratory on a Post-Doctoral Fellowship. Also: A. W. Manning, *Measurements of the Soft Component of Cosmic Radiation by an Absorption Well Method*, Journal of Atmospheric and Terrestrial Physics *10*, 189-193 (1957).

Among the two hundred or more Americans attending the sixteenth International Congress of Pure and Applied Chemistry and the nineteenth Congress of the International Union of Pure and Applied Chemistry, Paris, France, July 16-25, 1957, are included: Frederick D. Rossini, of the Carnegie Institute of Technology, Dr. F. F. Nord of Fordham University and Dr. George W. Schaeffer of St. Louis University.

Fordham Life, 2 (3), p. 6 for Jan. 1957, carries the picture of Fr. Clarence C. Schubert of the Chemistry Department in connection with the Fordham Building Drive.

Fr. Clarence C. Schubert has received $7500 from the Petroleum Research Fund of the American Chemical Society for the study of the Slow Oxidation Kinetics of Hydrocarbons. H. W. Posvic of Loyola University and A. B. Kemper of Manhattan College are named in the list of grants which appears in *Chem. & Eng. News* for Oct. 14, 1957.

Georgetown University. Dr. Francis M. Forster, Professor of Neurology and Dean of the Georgetown School of Medicine was named President of the American Academy of Neurology at the Academy's annual meeting in Boston, April 25th, 1957. During the course of this meeting, Dr. Forster's book *Modern Therapy in Neurology* was released by the C. V. Mosby Publishing Company.

The Kober lecture at Georgetown School of Medicine was delivered by Dr. Winchel Craig, eminent neurosurgeon. His subject was *Pain*.

Georgetown University recently received an outright grant of $100,000 for the improvement of medical education. The gift was from the Commonwealth Fund, a New York Foundation organized to assist in the improvement of mental and physical health.

Robert J. Hartman has been named Professor and Chairman of the Department of Chemistry at Georgetown according to *Chemical and Engineering News*, p. 116, October 7, 1957. He comes to Georgetown from Kanartex Coatings Inc., Galesburg, Ill.

Dr. Terrell L. Hill, of the Chemistry Faculty, gave a series of lectures on Thermodynamics at the Graduate School of Medicine at the University of Pennsylvania and went on a lecture tour through Quebec, Montreal, Kingston and Ottawa for the Canadian Institute of Chemistry.

Holy Cross College. Apart from the usual Jesuit status changes, staff changes in the Department of Mathematics, of which Fr. Raymond Swords is chairman, include: Dr. William E. Hartnett (Rockhurst College and the University of Kansas) and Dr. Patrick Shanahan (Universities of Notre Dame and of Indiana), who take up duties in September 1957. Junior student, Paul A. Schweitzer of Pelham Manor, N. Y., placed sixth in the Putnam National Mathematical Contest.

As a service to Catholic high schools in the area, a Mathematics Institute was conducted at Holy Cross during the month of July. The purpose of the Institute was to help high school teachers to keep abreast of recent developments and proposed changes in the high school mathematics curriculum, and to offer courses of instruction in topics from modern mathematics.

Classes were held Monday through Friday. During the first period each day a course was offered in mathematical structures (groups, fields, rings, ideals), functions etc. During the second period there was a treatment of set theory, Boolean algebras, probability, elements of statistics. The third period dealt with elements of topology, and eventually evolved into a discussion on the revision of high school courses in trigonometry and geometry.

Attending the sessions were 45 nuns representing five different congregations having houses in the Worcester area. The results were so successful that a repetition and expansion of the Institute is being planned for next summer.

According to a survey of Liberal Arts Colleges contributing to the chemical literature over the five years, 1952-6, made by John R. Sampey of Furman University, under the title, *Chemical Research in Liberal Arts Colleges,* 1952-1956, (J. Chem. Education, *34* (1957), pp. 352-3), Holy Cross placed eighteenth in a list of thirty-eight institutions, showing eleven publications. Canisius College came tenth with sixteen; Providence College, fifteenth with thirteen publications; Boston College, sixteenth with twelve publications; and Mount Mercy, twenty-third with nine publications.

The Fall Meeting of the American Chemical Society in New York featured a series of papers on a revised sequence of chemistry courses at the undergraduate level. The curriculum at Grinnell Col-

lege, Iowa, under the chairmanship of Dr. William Oelke, HCMS '28, came up for special discussion in the editorial of the September issue of the *Journal of Chemical Education.*

Fr. Fiekers taught Freshman Chemistry at Loyola University, Los Angeles, Cal., during July 1957.

St. Joseph's College. John H. Gibbon, Jr., M.D., the prominent Philadelphia surgeon, was the recipient of the annual Shaffrey award of the Medical Alumni of the College. The award is named in memory of the late Rev. Clarence E. Shaffrey, S.J., former professor of biology and chairman of the pre-medical department at St. Joseph's.

What follows is a brief report on the activities of the chemistry department of St. Joseph's College.

Dr. Joseph N. Bartlett was selected as chairman-elect of the Philadelphia section of the American Chemical Society.

Dr. George Beichl is chairman of the Continuation Courses sponsored by the ACS, and he is chairman of the Chemical Education Division of the Second Delaware Valley Regional Meeting, also sponsored by the ACS. Dr. Beichl delivered a paper at the ACS meeting in New York this past summer on *Interaction of Biphosphine and Diborane.*

By December, 1957, St. Joseph's College will have the following facilities completed: a research laboratory for further radiochemical studies; a constant-temperature instrument room, with facilities for eight or ten students; another research laboratory, with accommodations for approximately twelve graduate students.

The only glass blowing course in the Philadelphia area is being offered by the chemistry department.

This year we are offering a chemistry seminar for our undergraduate students. We have had speakers from Princeton, U. of Penna., Cornell U. The attendance includes students from other local colleges.

The graduate school of chemistry has set a new record for enrollment, with more than 70 students working toward a M.S. in chemistry in the evenings and on Saturday morning.

Le Moyne College. Fr. John J. O'Brien, Head of the Department of Chemistry, attended the Chemistry Institute for College Teachers, held during June and July 1957 at the University of North Carolina.

St. Peter's College. *Journal of Chemical Education* for September, 1957, *34,* pp. 444-6, carries an article by Prof. Thomas N. Dodd, on *A Simplified Magnetic Rotation Apparatus.*

University of Scranton. Prof. Joseph P. Harper is secretary-treasurer of the Central Pennsylvania Section of the American Association of Physics Teachers.

Varia. Recent Doctor of Philosophy awards to Jesuit Scientists include: Fr. Francis J. Koenig of the California Province in Chemistry from St. Louis University (goes to the University of Santa Clara); Fr. Joseph Hanzely, of the Maryland Province in Biology from the Catholic University of America (stationed in Wheeling, W. Va.); Fr. Ernest J. Bertin, of the Oregon Province, in Chemistry, from the University of Notre Dame (goes to Seattle University); Mr. Edward DesLoges, of the Missouri Province, in Physics, from St. Louis University (goes to Weston College for Theology); Mr. Robert Cloney, of the New York Province, in Chemistry, from the Catholic University of America (stationed at Woodstock College); Mr. Aloysius J. Panuska, in Biology, from St. Louis University; Mr. James S. Albertson, from the California Province, in Physics, from Harvard University (theology in Chantilly, France); and Mr. John MacDonnell of the New England Province, in Mathematics, from the Catholic University of America (stationed at Weston College), President of the Weston College Science Colloquium).

A Minimum Syllabus for a College Preparatory Course in Chemistry has been published by the New England Association of Chemistry Teachers in the *Journal of Chemical Education, 34,* 307-8 (1957). A limited number of reprints, while they last, are available from the Editor of THIS BULLETIN.

Dr. Paul F. Bailey, of Loyola University, New Orleans, La., gave an address entitled: the *Master Instructor,* at the presentation of the Honor Scroll of the Louisiana Chapter of the American Institute of Chemists to Dr. John R. Entriken on May 7, 1957. This address appears in *The Chemist* (34 (1957) pp. 333-5) and a group photograph of the presentation appears on the front cover of the September 1957 issue of that journal.

The *American Journal of Pharmaceutical Education,* summer issue, 1957, reveals membership of the following in the American Association of Colleges of Pharmacy (AACP): Loyola University (New Orleans) College of Pharmacy; Creighton and Fordham Universities. S. J. Creco of Creighton University is College Chairman of District 5 for 1957-8. John F. McCloskey, of Loyola University (New Orleans) is vice-president of the AACP. This issue of the journal contains reviews and abstracts of some unusual audio-visual items (16 mm. films, for example) of pathological, chemical and pharmaceutical interest.

John B. Drahman, of the University of Santa Clara, is secretary-treasurer of the Northern California Section of the American Institute of Physics Teachers.

Aus der Provinz for September, 1957, carries the obituary of Fr. F. X. Heselhaus, 1882-1957 (Sept. 1), biologist at Büren in Westf. He was the author of *Biologische Plaudereien,* reviewed in THIS BULLETIN, a few years ago.

The Strange Case of Cosmic Rays, shown over NBC stations at 9 P.M. on Friday evening, October 25, 1957, included a portrayal of the pioneering work of the late Reverend Theodor Wulf, S.J. Father Wulf, who invented the quartz-fibre electrometer, a forerunner of the Geiger Counter for the detection of radioactivity, set scientists on the track of a different kind of radiation which showers the earth from outer space. In his search for this added dose of radioactivity that his instrument always seemed to detect, he worked at first in caves under the ground. As his instrument seemed to become less sensitive there, he had to suspect that these rays came from outer space. So he climbed the Eiffel Tower in Paris. The higher he went, the greater the radiation. It remained for Dr. Victor Hess, Nobel Prize winner for this work and now Professor of Physics at Fordham University, to make a balloon ascent with Father Wulf's instrument. This clinched the argument that these rays came from outer space and since that time they have been called *Cosmic Rays.*

The obituary of Fr. Theodor Wulf, 1868-1946, Jesuit Physicist and former Provincial of Lower Germany, appears in *Mitteilungen aus den deutschen Provinzen der G.J.* (no. 117-) *18* (1), 52-56 (1957). This item contains a long extract from an earlier obituary by C. Piel in *Der mathematische und naturwissentschaftlicher Unterricht* for February, 1949. Reference is made to notices in THIS BULLETIN. This issue of the *Mitteilungen* also contains the obituaries of Fr. Joseph Fröbes, 1866-1949, eminent psychologist who once studied under Wundt, as well as that of Fr. Herman Krose, 1867-1949, an indispensable ecclesiastical statistician.

Jesuit Biologists, who worked at the Woods Hole Biological Laboratories, Summer 1957, included Fr. Joseph Burke, Fr. Charles A. Berger of Fordham University, Fr. Joseph E. Schuh of St. Peter's College and Mr. George Ruggieri of St. Louis University. Fr. B. A. Fiekers did not help out at the Woods Hole parish in the 1957 summer; but he did manage to visit the Scripps Oceanographic Institution in La Jolla, Cal. in connection with his summer school teaching at Loyola University of Los Angeles.

Fr. Pierre Le Jay, a member of the National Research Council of

France, will contribute the section on gravity measurements to the Annals of the *International Geophysical Year.*

Dr. Scott L. Kittsley, author of *Physical Chemistry* (College Outline Series, Barnes and Noble, New York, 1955) has been teaching at Marquette University, since 1945.

Spring Hill College, Mobile, Alabama played host to the Jesuit Seismological Association for its annual convention, August 16-18. The convention drew the best attendance the Association has had in recent years. Fr. Eisele's seismograph recorded several earthquakes during the convention.

Spring Hill College's new Chemistry Building, costing $200,000, will be dedicated in November of 1957.

At the 132nd Meeting of the American Chemical Society, held in New York, Sept. 8-13, 1957, Fordham University contributed ten papers; St. Louis University, two; Loyola University (Chicago), St. Joseph's College, St. Peter's College, Georgetown University and the University of San Francisco, one apiece. Non-Jesuit Catholic Universities contributed an approximately equal number.

Representatives on the Am. Chem. Soc. Council from our schools included Dr. C. L. Kenny of Creighton University, Fr. Arthur I. McNeil of Gonzaga University, Fr. B. A. Fiekers of the College of the Holy Cross, and Dr. W. F. O'Connor of Fordham University. Dr. O'Connor completes his term with the Council's Committee on Chemical Education this year; Fr. Fiekers has two years to go.

Alumni social events at the meeting were conducted by St. Louis University, the College of the Holy Cross and Fordham University. The latter, held on the Fordham Campus, constituted an alumni tribute to Dr. Leo K. Yanowski of the Fordham Staff, occasioned by his being one of the six professors in the country to win the *Outstanding Teacher Award* of the Manufacturing Chemists' Association early in the summer. Dr. Yanowski chairmanned a panel discussion in the open session of the Committee on Chemical Education dealing with Student Affiliate Chapters. He is also Radio Committee Chairman of the New York Section of the Society. Fr. George J. Hilsdorf is chairman of the special guidance committee of the same section.

Fairfield College Preparatory School can cite with justifiable pride the performance of alumnus, John H. Vickers, '53, who led his class at West Point, 1957, taking twelve of the twenty-nine military and academic prizes customarily awarded by the Academy. The *New York Times*, p. C-29, for Monday, June 3, 1957 gives the in-

ventory of his achievement. Congratulations to him, to his parents and to his academic mentors. Ed.

Journal of Chemical Education for November, 1957 (*34*, pp. 562-565) carries an exhaustive (non-sampling) survey entitled: *Achievement in First Year College Chemistry Related to High School Preparation* by Robert C. Brasted of the University of Minnesota in which the following, among many other interesting statements, are to be found: "In the course of the survey it became evident that students with preparation in parochial high schools performed at a higher level in the college chemistry courses than those from public schools.—" And again later: "The possibility existed that grading practices varied in different types of colleges and universities and that these differences might account for the higher index for students from parochial schools. Table 6 gives a comparison of students in the University of Minnesota taking college chemistry with preparation in parochial schools with the students in Catholic colleges with similar training. In both instances the performance is above the average of all of those with high school chemistry—." See the original article for geographical restrictions. Ed.

Cornerstone of the new Gymnasium, Cambridge (Mass.) High and Latin School, will contain copy of *I Was a Chaplain on the Franklin*, by the Rev. Joseph T. O'Callahan, S.J., according to the *Boston Herald* (rotogravure section) for Nov. 10, 1957. Father O'Callahan, *honorary* member of this ASSOCIATION, is a native of Cambridge, and an alumnus of Boston College High School, '22.

Weston College Science Colloquium. The thirty-seventh meeting was held on Sunday evening, September 29, 1957, at which Fr. Daniel Linehan lectured on the Geohydrology of New England. Mr. John E. Brooks introduced Fr. Linehan.

The thirty-eighth meeting was held on Sunday evening, October 20, 1957, at which Dr. James W. Meyer, research physicist at the Lincoln Laboratories of Mass. Inst. Tech., lectured on Miniscule Magnets in Modern Physics. Research here reported was supported jointly by the Army, Navy and Air Force under contract with the Mass. Inst. Tech. Mr. John J. MacDonnell, *theologian in third year*, is President of the Colloquium for the coming year.

Practica Quaedam

To complain to one's students in public that a lecture assistant has not supplied a tank of oxygen gas for demonstrations; and then to produce a pack of cigarettes from one's habit watch pocket and shake out of it a small *sparklet* tank of the gas—constitutes a good *gag*—to use a current expression. But the author had a piece of heavy rubber tubing attached for connection. Before returning the tank *in locum proprium* he had the brainstorm that solid fuel such as rubber might make a good substitute for the gaseous variety; he ignited the tubing; and used this simulated blow torch. On returning it to his pocket, a small spark lingered on the inner wall of the tubing, not to mention some leakage in the oxygen valve. After some minutes of his lecture, he made a swift pass at his pocket and shook out the contents: tank and pack, pencils and even May medals. This too was considered a *gag!*

Seriously though, a number of gases are supplied in such cartridge form today: oxygen, carbon dioxide, nitrous oxide and propane gas. Somehow they can be employed for improving our lecture demonstrations, without benefit of *laughing gas.*

Now that the second supplement to Beilstein, *Handbuch der organischen Chemie,* has been completed, and cumulative formula indexes to all three sections of the work are coming in, it might be well to note some changes in the scheme of the formula indexes, which might seem strange to users of the earlier edition of the formula index. The new index is arranged first by the number of carbon atoms in the compound listed; in each of these sections, by the number of hydrogen atoms; and finally by alphabetical sequence of other atoms, these in turn following in numerical sequence. Once this is known, a few seconds study of the index is rewarding.

We have found it awkward to make electrical connections to the prongs of electronic tubes, without benefit of a tube socket, when testing or modifying a tube circuit. One device is to pare the line lead to about the length of the pin; then to thread a sleeve of plastic tubing over the lead wire; and finally to bring this sleeve down over the pin and wire, thus fastening them securely together and providing insulation simultaneously. Polyethylene reservoirs on certain varieties of ball point pens, emptied and nipped to size, make ideal sleeves of this kind for most pins or prongs on common electronic tubes.

In our three-line, battery powered, *intercom* system, which has many stations, we have wired, parallel to the microphones at some strategic stations, a button and buzzer in series. Thus the buzzer sounds in the speakers and obviates the installation of buzzers at many of the other stations.

Chemi-Lume Lights for demonstrations of chemiluminescence are sold reasonably by the Varniton Co., 416 No. Varney St., Burbank, Cal.

Oxy-Catalyst, Inc., Wayne, Pa., produces an *Oxycat Unit* for educational institutions at $12 for lecture demonstrations and classroom work. Set on a tripod and brought to activation temperature by the flame of a Bunsen, it continues to glow after the flame is blown out though the supply of fuel is maintained. Attempts to ignite the gas above the unit will show that the fuel has been used up at the catalytic surface.

Simultaneous generation of chlorine gas by students in highly populated elementary chemistry laboratories has been a notorious and noisome nuisance. Fr. Gerard M. Landrey of Boston College seems to have the solution of this problem which so many instructors have striven to achieve. Instead of generating the gas in one flask and transferring it to a gas bottle, he prescribes generating it in the very gas bottle as needed. A small quantity of potassium chlorate ($KClO_3$) powder is sprinkled over the floor of the flask and concentrated hydrochloric acid is added dropwise to generate the chlorine, due caution being taken that concentrated sulfuric acid is *not* available in the laboratory at the time for students to use by mistake with resulting explosions.

This simple device suggests the use of *High Test Hypo* (*HTH*), true calcium chlorite, $Ca(OCl)_2$ with hydrochloric acid; the use of either in lecture demonstrations; even the use of sodium peroxide in lecture demonstrations for the generation of oxygen, but for the possibility that the alkaline by-product might absorb gaseous oxides of non-metals, if the oxygen were to be prepared for such a demonstration; and bisulfite for sulfur dioxide etc.

One of the papers delivered at the New York Meeting of the American Chemical Society in September showed among other things that a gas collection bottle, filled with water *ad meniscum* and covered with a small circle of filter paper, can be inverted so that the water is retained in the bottle by the paper. This should obviate the use of a glass plate to retain the water in the bottle when the latter is set up in a pneumatic trough—an impressive trick too. A submerged glass leader from the gas generator can be punched right through the wet filter paper.

Polaroid has come out with a film for copying materials onto transparent film for standard and miniature lantern slides. Development time lasts a minute longer than that of the regular Polaroid film. An obvious disadvantage is that a roll of eight pictures in many cases has to be used up immeidately if the camera is not to be tied up. As slide prices go, the cost seems reasonable, especially when the convenience of this system is considered. The Polaroid camera is becoming increasingly popular in laboratory photography.

Film Reviews

The Strange Case of Cosmic Rays. 16 mm., color, ca. 1 hour, Bell Telephone Co., from television broadcast, third in *Science Series*, first telecast on Oct. 25, 1957 over NBC network. The theme of this showing is the co-operation of scientific workers: linearly in the course of history; and simultaneously at the present time. It culminates in a plea for *harvest workers*. A *whodunit* theme is selected for the plot. The manikin characters, Dickens, Poe and Dostoevsky, comprise a board of judges to award a prize for the best mystery novel submitted to them. Modern science competes. Evidence is amassed to designate the *Fagin*, arch-thief, who masterminded the plunder of electric charges from Father Theodor Wulf's electrometer. This Jesuit physicist (1868-1946) tracked him to the top of the Eiffel Tower; Dr. Victor Hess followed him in a balloon to the threshold of outer space; Milliken *eff-bee-eyed* co-operative effort on a world-wide scale to indict the culprit. And the case stood.

The *scientific license*, taken at the expense of literary characters and their creators, is regrettable—retaliation, perchance, for the creation of Frankenstein and other literary license with scientific fact. The substitution of a gold-leaf electroscope for Father Wulf's quartz-fibre electrometer blinds one to the historical lesson that quantitative refinements in instrumentation initiate every great discovery in science. The unreverent inclusion of Father Wulf among the mannequins escapes serious contrast with the portraits of other investigators by appearing so early in the show. Reviewer could have supplied portrait material.

Yet throughout one gains an elegant insight into modern sci-

entific methodology, some acquaintance with the working of scientific instruments, and, granted a certain degree of concentration, a knowledge of the many particles that provide the *Building Blocks of the Universe,* as Wulf so aptly called them. Despite literary, scientific and other irreverence, this show finally recaptures the dignity of man and his dependence on his Creator. *bafsj.*

Eye to the Unknown (The Mass Spectograph), 16 mm. color and sound, 33 min., produced by Jack Copeland and Assoc., Consolidated Electrodynamics Corp., Mod. Talking Pic. Serv., 3-E54 St., NYC22. Almost any film on instrumentation can butter academic bread, especially on campuses which can better afford the flow of *oleo* than a spread of the primary product. Some films on instrumentation constitute an economic blend of both. In the case of *Eye to the Unknown,* this blend can be improved clockwise for academic consumption. For, its theme launches rapidly from the stout ways of chemical history and principles into the broad channels of application to culminate in the prospect of industrial automation. Still it is a worthwhile 33 minutes per student, alone from the conscious or sub-conscious symbol of the centrifugal separation of particles between the jaws of a powerfully magnetic capital-C. But only the most alert student will distinctly recall the preliminary production of magnetic properties in the particle itself.

At the outset, classical chemistry is pitted against mysticism and alchemy; and modern physics, against classical chemistry. Mysticism is mentioned on the sound track and it is very likely suggested in the picture of the cross that surmounts Joseph Priestley's desk. Fringe benefits among the applications include petroleum prospecting and refining, the detection of leaks in TV color tubes and many medical runs, such as the study of cancer as a *nitrogen trap* using N-15, and the control of hyperanesthesia involving CO_2 breath-analysis for a patient on the operating table. This patient, incidentally, is not the safety-oblivious technician from an earlier sequence, who puts his nose into a reaction in which gases are evolved, instead of wafting the vapors cautiously to his nostrils. Animation is interspersed. Numerous flash-backs review and conclude the showing. *bafSJ.*

The Petrified River. 16 mm., color, sound, 28 min., B of M in co-operation with the Union Carbide Co. The first half of this film deals with modern detection and mining of uranium; the second half is comprised of a number of AEC shots of the atomic pile and isotope production with appropriate descriptions. *bafSJ*

Our Mr. Sun. 16 mm., sound, color, 2 reels, 60 min. total, Bell Telephone Co. This film runs the gamut of astronomical facts and solar theory, the sun's composition, temperature and the like, to particular phases of supplying energy on this earth, in the form of food, fuels, water power, coal, oil and electricity. A number of unusual facts related to the sun is interspersed in interesting discussion, such as eclipses, the aurora and sun spots. Shots of contemporary research in the field of solar energy are provided.

Interest is sustained by *change of pace* in the selection of given topics by having a research scientist along with a science fiction writer interview Mr. Sun and his companion, Father Time, on a screen within a screen. The *plot* is a device to wheedle information out of Mr. Sun by divulging to him what we already know about him. The theme is reverent and severely iconoclastic of ancient cults of the sun. With St. Francis of Assisi, man is extolled over the other creatures including *Master Sun,* and homage is paid to God's Divine Providence Design is recognized in choosing Earth as man's habitat. On the other hand, however, the otherwise sunny optimism of scientists is clouded with the prospect of feeding the exponential surge of population which this film extrapolates. *bafSJ*

Chemical Instruments. 16 mm., color, sound, 14 min., Univ. of Southern California, from AV Ctr., Univ. of Mass. (restrctd). Introduction to this film contrasts tedious gravimetric with instrumental methods. Visual colorimetry introduces one to methods of optical instrumentation: the colorimeter, the nephelometer and the fluorometer. Algebraic and graphical computations are shown. Potentiometric balancing of two PE circuits, in order to compensate voltage changes in the line, is included. A modest amount of footage is allowed for the portrayal of ultimate applications. *bafSJ*

Editorial Notice

A number of abstracts of papers read at the Fairfield meeting have been omitted from this issue. In many cases we have received the full manuscript and we expect to publish such promptly in the next issue of This Bulletin. Ed.